NSEE WORKSHOP POSTERS

- Andrea Harmer and Sujata Jagota (Contact email: ajw1@lehigh.edu)

Nano IM: Nanotechnology Instructional Materials Development for Grades 7-12

This poster displays images from a multimedia CD created by the Jigyasa Eye on Science program funded through a previous NSF grant showing "The Many Facets of Carbon," including buckyballs and nanotubes. These materials will serve as a building block of our proposed Nanotechnology Curriculum and Instructional Materials Development for Grades K-12.

Nano U: An Interdisciplinary Multi-University Approach to Expedite Nanotechnology Education

This poster displays introduces the MatPAC, the Materials Pennsylvania Coalition of six-plus universities who collaborate to share nanotechnology education, research and facilities. For the past three years, the MatPAC has successfully expedited the sharing of advanced materials and nanotechnology education across the state of Pennsylvania and beyond.

- Aniket Bhattacharya (Contact email: aniket@physics.ucf.edu)

Self-Assembly of Lattice Amphiphiles

The poster demonstrates the feasibility of undergraduate students in carrying out simulation work in the area of nano self-assembly in soft matter physics. The poster also provides an outline of a course in nanophysics to be offered by the UCF physics department.

- Suzanne Lamminen (Contact email: lamminen@rice.edu)

The NanoKids: An Introduction to Nanoscale Science and Technology for Grades 6 - 12.

Answering an intense need for Nanotechnology educational materials, we have developed an NIMD proof-of-concept package using art and science in 3D animated lesson/adventures, including an interactive student workbook with educational games, a comprehensive teacher guide and parent overview, and a support web side with online evaluation and assessment instruments (nanokids.rice.edu).

- Mel Mendelson (Contact email: mmendels@lmu.edu)

Plan for Interdisciplinary Teaching of Nanotechnology to College Sophomores

We have developed a new sophomore-level course, Introduction to Nanotechnology, which will be offered in the Spring semester of 2004. Our course will integrate six basic science/engineering disciplines and bioethics. The course theme will be human biology via nanotechnology for improving the quality of life. Here the fundamentals and applications of molecular/cellular alterations and bio-engineered devices will be discussed.

- Crystal Nichols and William E. Dugger, Jr. (Contact email: cnichols@itea-tfaap.org)

Standards for Technological Literacy

The International Technology Education Association has developed *Standards for Technological Literacy: Content for the Study of Technology* (*STL*) as a basis for providing the content for what every student should know and be able to do in order to be technologically literate. Additional standards, which are based on *STL*, were generated that address student assessment, professional development, and program enhancement.

- Judy Vesel (Contact email: judy_vesel@terc.edu)

Meeting the Challenges of Creating Quality Science Materials for Grades 6-8

Presenters will share strategies for using an assessment-led approach to develop two prototype life science units that incorporate professional development materials for teachers and resources for administrators and families and extended families.

- Shang-Fen Ren (Contact email: ren@phy.ilstu.edu)

REU in China: International Institute of Nano-Science and Technology

We have been working on REU in China in the School of Physics at Peking University with a focus on nanoscience and technology supported by NSF for a few years. In this poster, our motivation, approach, events, student research projects, and student reports, etc, will be shown.

- Eric J. Voss (Contact email: evoss@siue.edu)

Nanoscale Experiments for the General Chemistry for Engineers Laboratory

Recently developed nanoscale experiments appropriate for the General Chemistry for Engineers Laboratory course will be featured. Experiments include: Solid State Structures, Periodic Properties and LEDs, A Shape Memory Alloy, Ferrofluid Nanoparticles, Disassembly of a LCD Watch, A Nanocrystalline Phosphor, Nickel Nanowires, and Decanethiol Monolayer on Silver. For more information see http://mrsec.wisc.edu/nano.

- Matthew A Tarr (Contact email: mtarr@uno.edu)

Summer Research Opportunities in Nanoscale Science for High School Students, High School Teachers, and Undergraduates.
M. A. Tarr, C. J. O'Connor, and I. DeLeon, Advanced Materials Research Institute, University of New Orleans.

The Advanced Materials Research Institute at the University of New Orleans has developed summer research programs in nanoscience designed to increase the awareness and understanding of scientific research among high school teachers, high school students, and undergraduate students from HBCUs. Such research-education integration programs may benefit NCLT or NUE projects.

- Mine Ucak-Astralioglu (Contact email: mgu1@psu.edu)

Bridging the Curricular Divide: Linking the Chemistry Curriculum Using Thematic-based Research Projects

The Penn State/ Chemistry Department is committed to develop undergraduate level nanoscience experiments, projects, and courses to create crossdisciplinary strength in emerging nanoscale science and technologies. Besides attracting student interest in nanotechnology, the workforce of tomorrow will be created by the collaboration of the research and the teaching faculty.

- Guy A. DeRose (Contact email: derose@its.caltech.edu)

NUE: Freshman Laboratory for Nanoscience

To motivate students to pursue careers in microelectronics, Caltech has developed a freshman lecture/laboratory course in which students obtain hands-on experience in the fabrication and characterization of semiconductor devices. We describe a major upgrade to this popular course (taken by about half of the entire freshman class) with the acquisition of high-resolution lithography equipment.

- Darrell Porcello [porcello@uclink.berkeley.edu]

Windows on Research: Nanotechnology, Future Exhibit at the Lawrence Hall of Science, University of California, Berkeley

Come check out the progress of one of the first Nanotechnology exhibits within an informal science education setting. See pictures and read descriptions of the many components of this growing exhibit. A developer will be on hand to discuss our recent successes and remaining challenges.

- Michael Thaddeus Niemier (Contact email: mniemier@cc.gatech.edu)

Teaching students computer architecture for new, nanotechnologies

Explores how to introduce nanotechnology into systems-level computer engineering curriculum (especially targeting undergraduates)

- Paul Petersen and Katherine Mayberry (Contact email: pepeee@ritvax.isc.rit.edu)

Developing an Undergraduate Course in Nanotechnology: Applications, Principles, Ethics, and Social Change

This two-board poster describes the approach used to develop the three quarter course sequence in Nanotechnology. It follows that with a quarter by quarter description of the course content and concludes with RIT's vision for the future.

- Wendy C. Crone (Contact email: crone@engr.wisc.edu)

Integrating Nanoscale Science and Engineering into the Undergraduate Engineering Curriculum (NUE at University of Wisconsin - Madison)

Wendy C. Crone, Ken Lux, Robert Carpick, Engineering Physics; Don Stone, Eric Hellstrom, Materials Science and Engineering, University of Wisconsin - Madison

Our work integrates nanoscale science and engineering educational modules into key introductory and advanced undergraduate courses in the College of Engineering at the University of Wisconsin – Madison. The six courses targeted for modification range from freshman introductory courses to advanced level materials and mechanics courses.

Instructional Materials from the University of Wisconsin – Madison Materials Research Science and Engineering Center on Nanostructured Materials and Interfaces

The UW MRSEC has developed a suite of instructional materials, including numerous kits, software, teaching modules and articles about nanotechnology, based on cutting-edge research around the theme of nanoscale science and engineering. The *Laboratory Manual for Nanoscale Science and Technology* gives a series of movie-based laboratory experiments for teaching nanotechnology at the high school and college levels. The *Nanoworld Cineplex* contains movies of experiments and demonstrations that can be brought into classrooms and laboratories. For more information see our web site: http://mrsec.wisc.edu/nano

Using Chemistry to Create Nickel Nanowires

A. K. Bentley, M. Farhoud, G. C. Lisensky, W.C. Crone, Department of Engineering Physics, Department of Chemistry and the Materials Research Science and Engineering Center on Nanostructured Materials and Interfaces, University of Wisconsin – Madison

Traditional methods used to synthesize nanoscale materials can require expensive equipment and time-consuming multi-step procedures which are beyond the reach of high school and introductory-level college chemistry students. In contrast, the nanowire synthesis lab presented here uses a simple electrochemical method common in research laboratories to make nickel nanowires and analyze their behavior. The web-based lab manual for this experiment can be found at http://www.mrsec.wisc.edu/edetc/cineplex/nickel/index.html

A Microfluidic Nanofilter Laboratory

W.C. Crone, R.W. Carpick, K.W. Lux, Department of Engineering Physics and the Materials Research Science and Engineering Center on Nanostructured Materials and Interfaces, University of Wisconsin – Madison

A new course on *Micro- and Nano-Scale Mechanics* was recently taught at the University of Wisconsin - Madison for engineering and physics students. This course provided an introduction to nanoscale engineering with a direct focus on the critical role that mechanics plays in this developing area. The laboratory component of the course involved several modules that build upon one another such that a microfluidic device that filters an aqueous suspension of gold nanoparticles is constructed by the end of the course. The construction and testing of this device provides the students with an opportunity to investigate several nanotechnology and microfluidic phenomena during the course of the semester. The web-based lab manual for this experiment can be found at http://www.mrsec.wisc.edu/edetc/nanolab/index.html

Exploring the Nanoworld with LEGO® Bricks

Dean J. Campbell, Bradley University and the University of Wisconsin – Madison Materials Research Science and Engineering Center on Nanostructured Materials and Interfaces

The UW MRSEC has developed instructional materials to show how various physical and chemical principles related to nanoscale science and technology can be demonstrated with LEGO® models. There are a number of reasons to consider using LEGO® bricks for this purpose. First, many people are familiar with LEGO® bricks, and most models can be built with a level of mechanical sophistication that does not intimidate or frustrate the user. Second, LEGO® bricks typically have many connection points, allowing tremendous flexibility in the structures that can be built. A set of bricks can be used to model structures of matter and the techniques used to study them. Additionally, three-dimensional models are excellent tools for grasping structure-function relationships. For more information see our web site: http://mrsec.wisc.edu/LEGO/index.html

Education Efforts of the Materials Research Science and Engineering Center on Nanostructured Materials and Interfaces at the University of Wisconsin – Madison

The UW MRSEC's Education and Outreach objective is to introduce people of all ages to nanostructured materials and the tools that let us "see" atoms, manipulate atoms, and customize those materials. Through hands-on, inquiry-based activities at schools, museums, and community events, we ask people to investigate the frontiers of advanced and nanoscale materials. Our work revolves around a central theme entitled *Exploring the Nanoworld*. We work to enhance science literacy by creating new instructional materials based on current advances in nanoscale science and technology. These instructional materials have helped to bring new life to traditional science curricula by incorporating examples of innovative and cutting-edge materials research. For more information see our web site: http://mrsec.wisc.edu/nano

- Judith Light Feather (Contact email: Judith.LightFeather@TNTG.org)

(UCF/TNTG) National Center for Learning & Teaching in Nanoscale Science and Engineering

Rapid advances in nanoscience and nanotechnology—the manipulation of matter at the atomic and molecular levels—are profoundly influencing the manner in which we conceptualize the world of the future. Although nanotechnology research is still in its infancy, early successes have prompted a need for long-term investment in infrastructure development, especially in the area of formal science education at grades 7-16. This project will focus on undertaking national scale research into how fundamental principles in nanotechnology may effectively be taught at grades 7-16. The research will include the integration of nano, bio ,info ,cogno as directed by the NSF. The Center will also research platforms that will address students with Attention Deficient Disorder and hearing impairment. Technical workforce learning and Corporate training as Informal education is a priority, along with Social Implications and Public awareness programs as Education Outreach. The Center will disseminate findings and implications from this research to institutions and organizations (nationally and internationally) involved in nanotechnology research and associated K-16 nanotechnology outreach programs. The overarching goal of the UCF/TNTG National Center for Learning & Teaching in Nanoscale Science and Engineering is to serve as an exemplar for fundamental research into effective learning and teaching methods in nanoscale science, grades 7-16 which can be implemented in the classrooms before the end of this decade.

NIMD – Virtual Nano-lab add-on Module Prototypes for Grades 7-12

Development of NanoScience Modules and Interactive Virtual Nano-Labs for use in middle/high school science curricula. The prototype modules will be developed as add-on in-depth instructional materials which can be easily adapted to the current teaching syllabus. Introducing nanoscale science and the instruments used in research laboratory situations with visual elements and animation where appropriate stimulate student interest in STEM education. The use of visual elements assures the retention of difficult concepts based on current research. The inclusion of experiments with the

virtual nano-lab environment introduces real experiential science inquiry and scientific methods of discovery stimulating early student interest in a STEM career path. The modules will have teacher guided controls on the Beginners and Intermediate, while the Advanced will allow students in 11^{th}-12^{th} grade actual hands-on control and group interaction with their lab experiments. Built-in assessment tools will allow easy evaluation of student comprehension and teacher survey tools will be included in the packaged modules produced on CD/DVD for easy access in the classroom.

NISE – Informal Science Nano Documentaries and Programming Media Project

Programming for our project will be developed for our current NanoNEWS.TV online broadcast platform along with HDNet Cable TV stations, allowing outreach for the United States market and the International market for total global impact. The project will produce three half hour documentaries per year developed as Informal Science Education for grades 7-16 explaining all phases of nanoscale science and technology as a primer for informal education of students and adults. Titled: **"Nano for People…It's NOT Science Fiction**" the documentaries will be created with graphics, interviews, and examples of products already in the marketplace, while stimulating excitement for a very different future. In addition our project will produce 12 nano news programs per year for 5 years, developed to create public awareness of the NSF funded Nano Centers, University R&D projects, and Nano Educational projects, while introducing the people working behind the scenes in R&D for the science and technology. The programs will also address Social Implications and the website will provide a format for public interaction as the programs are aired. This news format is designed for all ages to significantly impact public awareness in the private sector.

Broadcast Title for Documentary Series:
"Nano for People…It's NOT Science Fiction"
15 episodes over 5 years

Broadcast Title News Programming:
"Nano for People- An Insider's View"
Introducing Nanotechnology News as Public Education Outreach
Host: Andy Shaw
60 episodes over 5 years

NISE- Education Game Platform and Traveling Museum Exhibit

"Nanonaut©Race to Mars" Trans-disciplinary Game Platform-Grades 7-12

Developed to introduce nanotechnology and the science as it pertains to the future missions in space travel and colonization through a series of role-playing games developed as a platform for education. The game storyline challenges students in grades 7-12 to become the next generation of astronauts in the 2015-2020 Space

Program, which will require they learn the integrated science fields of chemistry, physics, and biology along with math, fractal geometry and engineering to understand the technology of the future. Using the game platform for education allows the students to retain difficult concepts due to the combined use of visual elements versus text, virtual characters that allow them to role play the story and virtual reality environments to enhance the experiential learning aspect creating an adventure with challenges to learn new skills.

The Introductory videos showing the first phase of the interactive game will be put on tour in the fall of 2005 through 2006 in cooperation with Science and Technology Museums and Planetariums. Using the platform to create scenarios for a mission to Mars allows math and science to be interwoven resulting in curriculum that is stimulating and productive addressing the recent report "Before It's Too Late" from the National Center for Educational Statistics (NCES) in "The Condition of Education 2003."

Game Series:
3 Episodes will be developed, each consisting of 15-20 hours education within the structure.
Episode One- Nanonauts© Training
Episode Two-Preparing your Mission
Episode Three-Race to Mars.